

# Discovery at Your Doorstep

From Camp Upton, the Birthplace of  
'God Bless America,' to a National Lab,  
Seven Nobel Prizes, and More

David Manning  
Director, Stakeholder Relations &  
External Affairs

**70** YEARS OF  
**DISCOVERY**

A CENTURY OF SERVICE



# First, a Little History



CAMP UPTON

A MAP OF  
LONG  
ISLAND

GOOD SWORDFISHING HERE

Published by The Billboard Barn,  
Southampton, Long Island (1933, 1961)

# Before Brookhaven: The U.S. Army's Camp Upton

**1917:** Camp Upton is founded

**1918:** Soldier Irving Berlin writes "God Bless America" and "Yip Yip Yaphank" at Camp Upton

**1944:** Camp Upton converted into a convalescent and rehabilitation hospital for wounded veterans returning from World War II



# Brookhaven Lab Today

## The Atom Smasher

Relativistic Heavy  
Ion Collider

## NASA Space Radiation Lab

## Medical Isotope Maker

Brookhaven Linear  
Isotope Producer

## Magnet Makers

## Chemistry

## Biology

## Environment, Nonproliferation, And More

## Physics

## Energy Research Hub

Interdisciplinary  
Science Bldg.

## Detector Designers

Instrumentation

## Ultra-small Science

Center for Functional  
Nanomaterials

## Accelerator Test Facility

## Data Crunchers

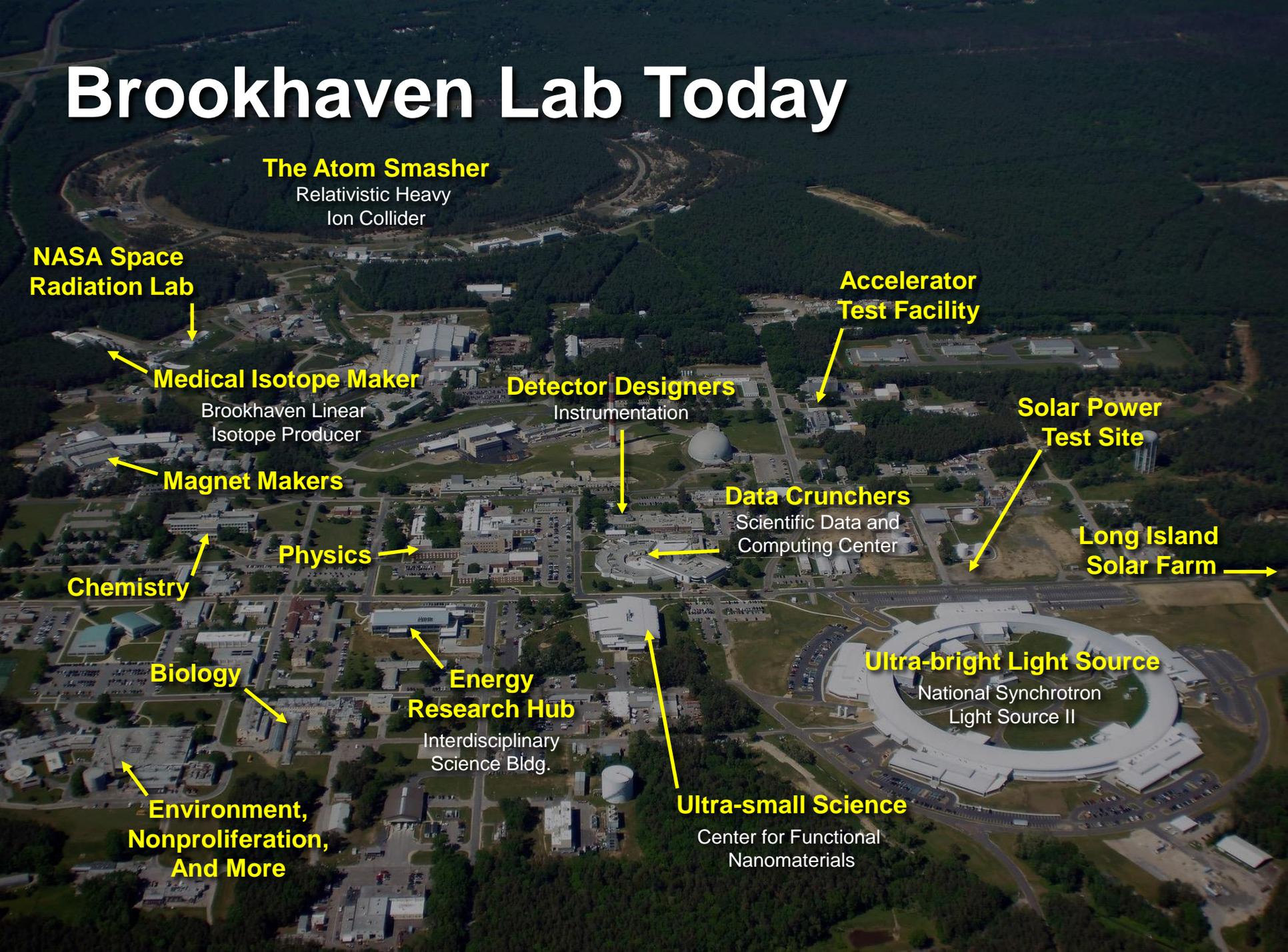
Scientific Data and  
Computing Center

## Solar Power Test Site

## Long Island Solar Farm

## Ultra-bright Light Source

National Synchrotron  
Light Source II



# Brookhaven Lab Today



U.S. DEPARTMENT OF  
**ENERGY**

**We support DOE's mission to ensure America's security and prosperity by addressing its energy, environmental, and nuclear challenges through transformative science and technology solutions.**

**—in short—**

**We discover the solutions to power and secure America's future.**

# Brookhaven Lab Today

The 17 national labs are unique, helping address DOE's mission by:

- Building, operating big machines a university or company could never build on its own—these facilities require national support
- Forming teams, both within labs and across the DOE complex
- Complementing, competing, and collaborating

## Office of Science Laboratories

- 1 Ames Laboratory  
Ames, Iowa
- 2 Argonne National Laboratory  
Argonne, Illinois
- 3 Brookhaven National Laboratory  
Upton, New York
- 4 Fermi National Accelerator Laboratory  
Batavia, Illinois
- 5 Lawrence Berkeley National Laboratory  
Berkeley, California
- 6 Oak Ridge National Laboratory  
Oak Ridge, Tennessee
- 7 Pacific Northwest National Laboratory  
Richland, Washington
- 8 Princeton Plasma Physics Laboratory  
Princeton, New Jersey
- 9 SLAC National Accelerator Laboratory  
Menlo Park, California
- 10 Thomas Jefferson National Accelerator Facility  
Newport News, Virginia

## Other DOE Laboratories

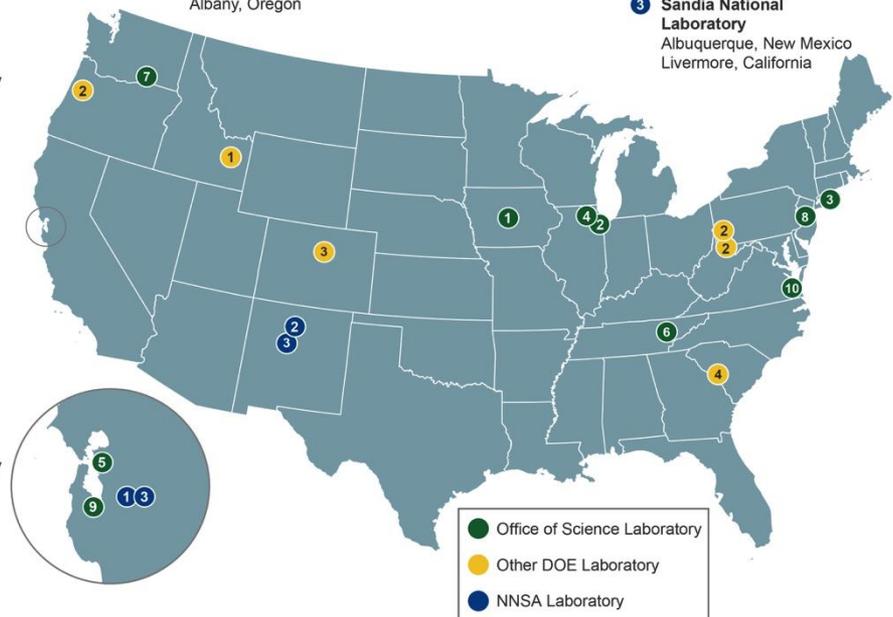
- 1 Idaho National Laboratory  
Idaho Falls, Idaho
- 2 National Energy Technology Laboratory  
Morgantown, West Virginia  
Pittsburgh, Pennsylvania  
Albany, Oregon

- 3 National Renewable Energy Laboratory  
Golden, Colorado

- 4 Savannah River National Laboratory  
Aiken, South Carolina

## NNSA Laboratories

- 1 Lawrence Livermore National Laboratory  
Livermore, California
- 2 Los Alamos National Laboratory  
Los Alamos, New Mexico
- 3 Sandia National Laboratory  
Albuquerque, New Mexico  
Livermore, California



U.S. Department of Energy, via Wikimedia Commons

# Brookhaven Lab Today

## Numbers

- Employees: 2,600
- Jobs in NY State: approx. 5,400
- Users: 4,000 per year (600+ from Stony Brook)
- Grad/Undergrad students on payroll: 400
- Total funding for FY 2017: \$582 million
  - \$517 million from the U.S. Department of Energy
  - \$65 million from other agencies

## Details

- One of 17 U.S. Department of Energy national laboratories
- The Northeast's only multi-program DOE Office of Science lab
- Managed by Brookhaven Science Associates

## Key partnerships

- New York State
- Stony Brook University
- Battelle



Doon Gibbs  
BSA President,  
Brookhaven Lab  
Director



Robert Tribble  
Deputy Director  
For Science &  
Technology



Jack Anderson,  
Deputy Director  
For Operations

# Brookhaven Lab Today

## Brookhaven Science Associates' Board of Directors

Representing world-class institutions:



Ronald D. Townsend  
BSA Board Chair  
Executive Vice President,  
Global Laboratory  
Operations, Battelle



Samuel L. Stanley, Jr., M.D.  
BSA Board Co-chair  
President,  
Stony Brook University



# Major Awards

## Nobel Prizes



1957



1976



1980



1988



2002



2003



2009

## Other prestigious honors

National Medal of Science: 5

Enrico Fermi Awards: 5

Ernest Orlando Lawrence Awards: 12

National Medal of Technology: 2

Wolf Prizes: 2

National Academy of Science,  
National Academy of Engineers: 22



*Esther Takeuchi,  
Chief Scientist  
Energy & Photon  
Sciences*

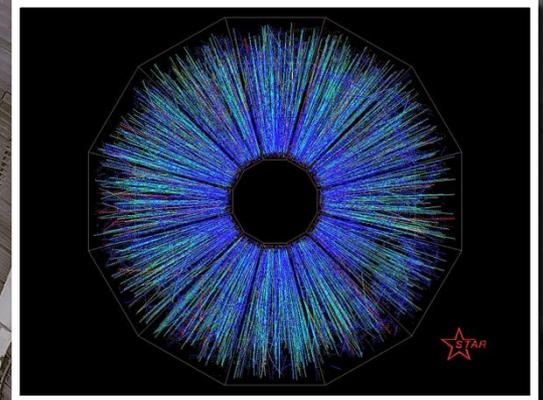
# Inside RHIC

## Unlocking the mysteries of matter and mass, and why the universe works the way it does

- 1,000+ scientists, engineers, and students from around the world
- Used to explore the "strong force" and 0.00001 seconds after the birth of the universe
- Discovered quark-gluon plasma, a "perfect" liquid at 7 trillion degrees Fahrenheit

## Strategy for the future

- Measure the extraordinary properties of the perfect liquid
- Transition from RHIC to eRHIC to learn what's at the heart of all visible matter
- Applications of nuclear science



# RHIC's Accelerator Complex

## Space travel

- At the NASA Space Radiation Laboratory, particle beams from the RHIC accelerator complex simulate cosmic radiation to study health risks associated with longer missions in space and to Mars!

## Radioisotopes—medical treatments—that save lives

- Brookhaven Linear Isotope Producer for medical isotopes not commercially available
  - We produce half the United States' strontium-82 for generators to assess heart health
  - Collaborating on research for cancer therapy: Can produce Actinium-225, an "alpha-emitter" for noninvasive treatment, kills cancer cells with minimal damage to surrounding tissue

## Particle detectors for health, national security

- Brookhaven experts have built detectors for countless experiments, PET detectors to diagnose disease, and radiation detectors that contribute to our nation's security



# Inside NSLS-II

**The brightest light source of its kind, for unprecedented capabilities, advances**

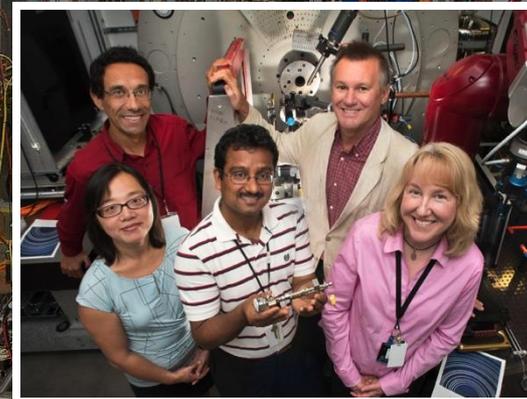
- 10,000 times brighter than its predecessor, NSLS
- 1,000 users per year (3,000 by FY20)

## **Research for energy challenges**

- Advanced electrical storage
- High-temperature superconductors for the electric grid
- Fuel cells based on nanocatalysts
- Plant/environment interactions

## **Studying proteins, viruses to fight disease**

- ABBIX beamline suite, funded by the National Institutes of Health
- Cryo-EM: Partnering with Stony Brook, Cold Spring Harbor, and New York State



# Inside the CFN

## Research at the ultra-small nanoscale for big advances in energy, national security, more

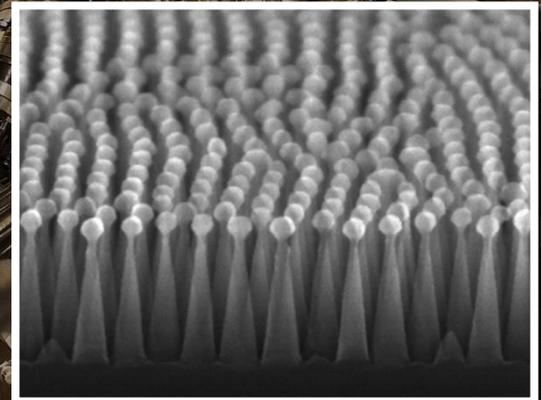
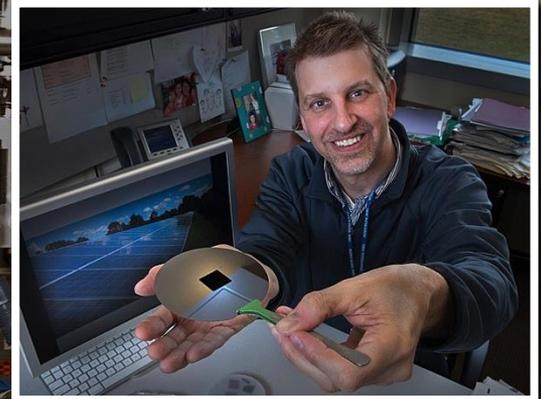
- Designing structures measured in billionths of a meter
- Advancing nanoscience research and hosting hundreds of guests each year

## Nanoscience for solar panels... and ski goggles?

- Antireflective surfaces: Inspired by insects' eyes, nanotextured surfaces can dramatically increase light collected by solar panels
- Hydrophobic surfaces: "Nanocones" prevent moisture from accumulating—water droplet literally jump off

## Breaking a world record at the CFN

- For electronics, "lithography" processes create complex materials with specific patterns and compositions
- CFN scientists became the first to use electron-beam lithography to pattern materials at the size scale of one nanometer



# 'BIG Data' for Science, Beyond

## A storage, processing powerhouse

- Home to the second largest scientific data archive in the entire United States, fourth largest in the world
- 100 petabytes stored: equivalent to the data to stream high-def video 24 hours a day, seven days a week for...340 years

## A competitive advantage today— and tomorrow

- Recognized internationally for advanced, high-throughput computing—acquiring, processing, analyzing, and distributing data
  - RHIC/ATLAS Computing Facility, a tier-1 data center
- "Autonomous optimal experimental design" (artificial intelligence), to analyze data in near real-time, steering discovery as it happens
- Identifying patterns, processes in dynamic environments can benefit science, energy applications, finance, pharmaceutical research, more



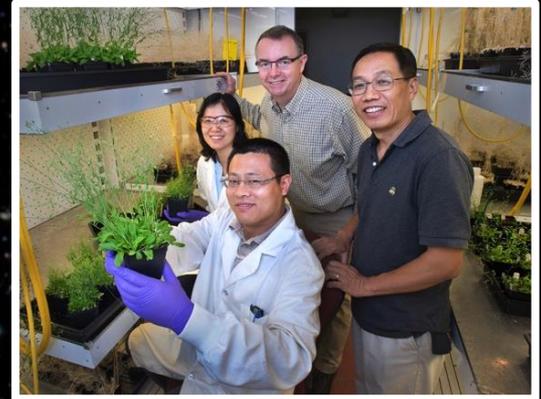
# From 'Dark Space' in Plants To Dark Matter and Energy in Space

## 'Quantitative Plant Science Initiative'

- Illuminating plant "genomic dark space" to discover plants genes we currently know little or nothing about
- Will enable the development of sustainable sources for biofuels and bio-products

## Large Synoptic Survey Telescope's 3,200 megapixel sensor

- Leading development of the sensors for the LSST's digital camera
- Located in Chile, LSST will capture light from stars 100 million times dimmer than the dimmest star visible to the naked eye
- With a wide-angle view, will quickly survey the entire night sky, "looking for light" from dark matter and dark energy that account for approximately 95 percent of the universe—all we see in the universe is 5 percent



LSST Project/NSF/AURA

# Students Today, Scientists Tomorrow

The Lab community must be diverse—among its people, experiences, and solutions—to address the nation's challenges.

## Science in classrooms, labs, and Long Island's great outdoors

- 30,000+ Long Island students in grades 1–12
- Science Learning Center on site, DOE's National Science Bowl, High School Research Program, "Day in the Life of a River," My Brother's Keeper, "telecommuting" from the classroom to NSLS-II for real research
- Exploring physics, energy storage, nanoscience, coding, more

## Long Island STEM Hub

- Led by Brookhaven and Northwell Health, collaborators at regional universities, school districts, museums, and industry—to introduce and inspire students to pursue careers in STEM on Long Island

## University Students, Professors

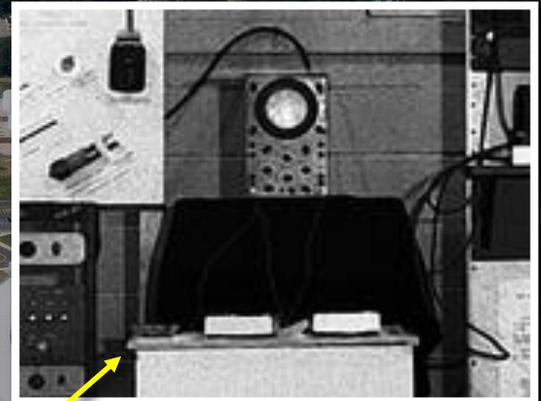
- 350+ students and professors from universities across the country participate in internships, tours, and workshops



# Billion-Dollar Impacts

## Encouraging the spirit of entrepreneurship: promoting start-up companies, granting licenses, and taking equity in ventures

- Corrosion-prevention coating for metals with newly revealed properties of nanoparticles
- Sequenced the T7 virus genome for a system for producing proteins used in biomedical research, diagnostics, and treatment
- Patented Maglev
- Developed cleaner-combusting oil burners, saving consumers approximately \$25 billion in fuel costs and keeping 160 megatons of carbon dioxide out of Earth's atmosphere
- Created first successful PET scan radiotracer,  $^{18}\text{F}$ FDG, now used to study the nervous system and image cancer
- Synthesized human insulin to treat diabetes
- Developed Technetium-99m, the most widely used radioisotope for imaging diseased organs
- Developed L-dopa, gold standard for treating Parkinson's disease
- Invented "Tennis for Two" in 1958—often called the world's first video game—which led to a multi-billion-dollar industry



# Looking to the Future

## Brookhaven National Laboratory TEN-YEAR CAMPUS VISION

Delivering the next decade of science while transforming the Laboratory Campus with a diverse investment portfolio



**Federal**  
Focus key future Federal investment in additional core building renovation to enable the scientific agenda

**Indirect**  
Make research safe and cost effective by downsizing the campus and demolishing old buildings

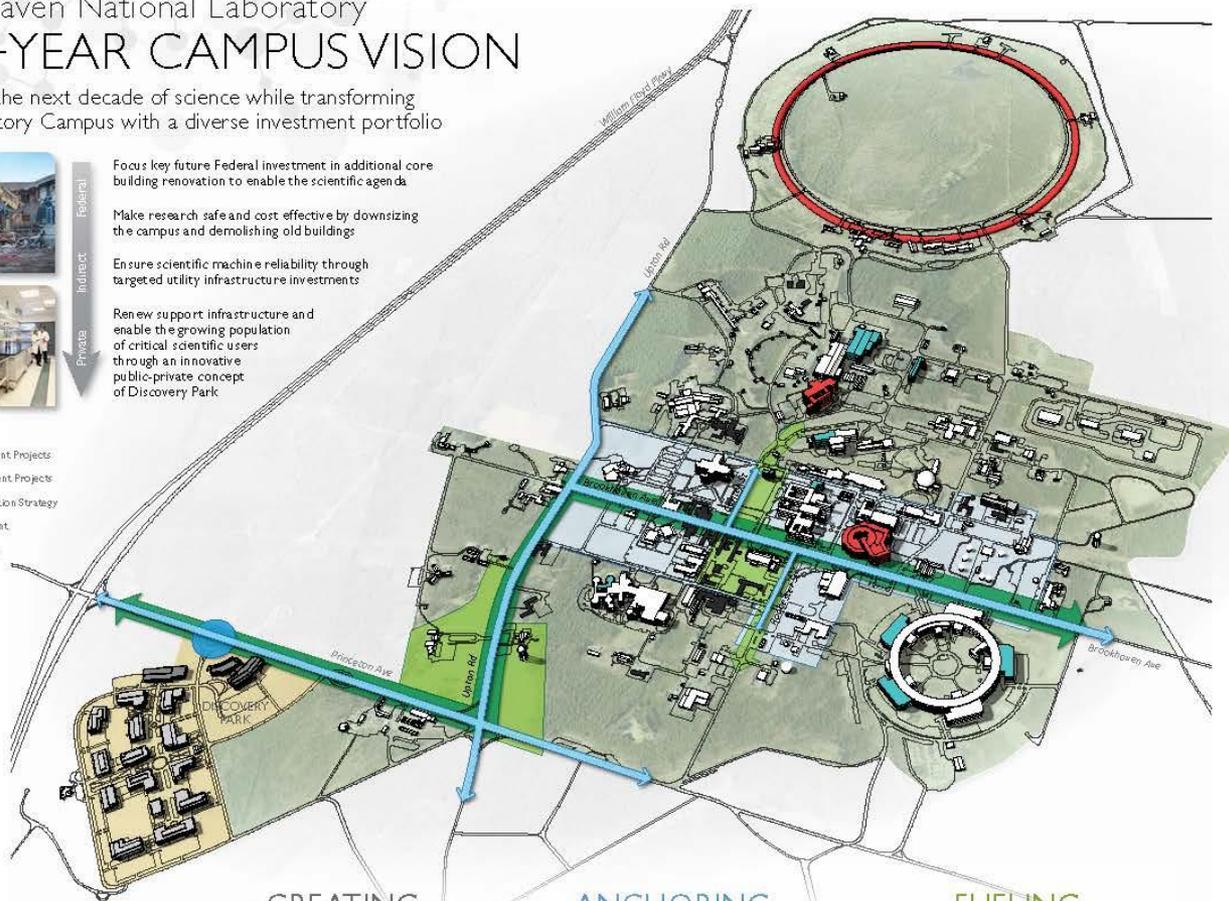


**Private**  
Ensure scientific machine reliability through targeted utility infrastructure investments

Renew support infrastructure and enable the growing population of critical scientific users through an innovative public-private concept of Discovery Park

### KEY

- Federal Investment Projects
- Indirect Investment Projects
- Footprint Reduction Strategy
- Private Investment
- Existing Building



**CREATING**  
the Gateway

**ANCHORING**  
the Development

**FUELING**  
the Impact

Public-Private Partnership  
Investment Phases

Federal Indirect

Incentized Partnership

Private

- ▶ Roundabout
- ▶ New Security Portal
- ▶ Phased Demolition

- ▶ Utilities
- ▶ Entrance Building with Initial Office Component
- ▶ Housing
- ▶ Transportation

- ▶ Technology Incubation
- ▶ Private Collaboration Facilities
- ▶ Community/Economic Development



**DISCOVERY PARK**  
A public-private partnership

### SCIENCE MISSION

Creates	Results
New general purpose administrative, user processing, conference & collaboration space, and high density housing	<ul style="list-style-type: none"> <li>Enables demolition of 300,000 SF of old inadequate wood buildings</li> <li>Improves space utilization by 15%</li> <li>Eliminates \$24M of repair and ESH legacy deficiencies</li> <li>Provides user amenities and renewed housing to attract the growing scientific user population</li> <li>Opportunity for scientific partnerships and Technology Transition</li> </ul>

### COMMUNITY IMPACT

Creates	Results
A new "front door" with community access and visibility, energy showcase, STEM education and student engagement	<ul style="list-style-type: none"> <li>Expands opportunities for community outreach, engagement and highlighting the technology mission and value</li> <li>Grows the current impact of 35,000 students in STEM education programs</li> <li>Grows a critical mass of people and activity that enables user services</li> <li>A "sense of place" to attract young scientists</li> </ul>

### ECONOMIC DEVELOPMENT

Creates	Results
Energy test bed Private user office and work space Technology incubation	<ul style="list-style-type: none"> <li>Leverage the NYS investment and the BNL research agenda in energy for the Northeast Region</li> <li>Enable collocation of partner facilities such as the proposed New York Center for Grid Innovation (NY CGI)</li> <li>Regional economic development with new companies and new product development in key areas of research</li> <li>BNL engagement in the emerging Long Island BioTech Cluster</li> <li>Technology Incubation</li> </ul>

# BROOKHAVEN LABS

FOR THE UNDERSTANDING/COMPLEX ANALYSIS OF:

← QUARK-GLUON PLASMA

→ ELECTROSTATIC ACCELERATION

← PARTICLE BEAMS

→ SUFFOLK CO. GOVERNMENT PARTY/POWER STRUCTURE

